RIVER SAND AS A FILTER MEDIUM[1]

By L. A. Fritze[2]

In the selection of sands for filtration purposes, it has been common practice to use the uniform kinds usually obtained from banks or the sea coast. Bank sands are to be found in different parts of the country, yielding a product which has proved very efficient as a filter medium.

The filter plant proposing to use these screened, sharp sands, generally finds the cost very high, so high some times as to almost make its use prohibitive.

To offset this cost, other sands have come into use, and prominent among them is river sand. If a river sand can be found free from mud and other objectionable matter and of a uniform size, there is no reason why it will not give satisfaction as a filter medium. If clay, mud, etc., be present, its removal may offset the financial advantage and make the bank sand cheaper in the end.

However, in this paper, advantage will be taken of the fact that clean, uniform sand can be obtained from river beds, and our cost data will be based on this product.

In some of the older plants in this country, river sand has been in use for a number of years, with results that are very satisfactory.

In slow sand filtration and rapid sand filtration alike, these cheaper sands have been in service from seven to twelve years, and the results prove that a satisfactory effluent may be obtained.

Since the installation of bleaching powder and other sterilization agents, as an additional aid to purification, the necessity for a sand of such high merit as formerly is not now of such exacting importance. However, the size of the sand must be considered, for one too fine will clog quickly, and one too coarse will not yield a satisfactory effluent.

In rapid sand filtration, the use of river sand has become quite common. Inquiries sent to a number of these plants show that a

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[2] City Chemist, Moline, Illinois.

very satisfactory water has been obtained with a sand one-fourth the former cost.

In Moline and Rock Island, the experience has been the same. River sand has been in service for two years with results which indicate its permanent use. This sand is obtained from the Mississippi River, above the city of Moline. A local sand company supplies the material, collecting it in the following manner. By means of a centrifugal sand pump on a boat, a barge is loaded. This barge is then unloaded at the docks of the company by a stream of water from the sand pump, into the river again. After emptying the barge, the sand is then taken from the river and pumped into the sand bins. By this means of unloading, the sand is thoroughly washed and freed from objectionable matter.

This raw, unscreened product has an effective size of 0.28 mm. and a uniformity coefficient of 2.11. When placed in a filter, the fine powder will find its way to the surface during washing. Unless this powder is removed, the filter will clog very quickly and necessitate an increase in wash water. By scraping the bed and freeing the sand of this material, a medium will be obtained with an effective size of 0.51 mm. and a uniformity coefficient of 1.34. For filtration purposes this sand is very efficient.

The loss due to the discarding of the fine powder will vary with the different sands, ranging from 5 to 40 per cent. The Mississippi sand contains about 5 per cent fine powder, which is very easily removed by washing.

It has been found that the size of gravel used will effect the results obtained with river sand. Small gravel $\frac{3}{4}$-inch to $\frac{1}{4}$-inch was in use for a year, but the results show that larger gravel is needed. To meet this, gravel 2 inches and over was placed next to the strainers to a depth of 9 inches. With the smaller gravel on this bed and the sand on top, conditions are very satisfactory. This filter has been in service six months and to date there has been no packing and strainer trouble.

Likewise in Rock Island, it was found necessary to supplant the fine gravel with the larger material, when the river sand was employed. Using the larger size gravel has eliminated considerable of their trouble.

The financial saving of the river sand over the more expensive bank sands is considerable. The cost of the Mississippi River sand per cubic yard delivered to the filter plant is 70 cents. The loss in

this sand due to the fine powder is 5 per cent, making the actual cost per cubic yard 72.9 cents.

Large gravel to the depth of nine inches is needed to obtain satisfactory results. This quantity represents about nine cubic yards and costing $2.35 per yard, totals $21.15. This cost must be added to that of the sand.

The wash water required to free the sand of the fine powder is 125,000 gallons and costing one cent per 1000 gallons, totals $1.25.

Considering these additional factors, the cost of the river sand ready for service in the filters is $1.47 per cubic yard.

For comparison, selecting a well known bank sand, commonly in use in this section of the country, that from Red Wing, Minnesota, the best grade of filter sand obtained at this place costs $3 per ton or $4.05 per cubic yard. The freight from Red Wing to Moline is $1.80 per ton or $2.43 per cubic yard, making a total cost per cubic yard, delivered to the filter plant, of $6.48. An additional charge of 25 cents per yard must be made for unloading, bringing the total cost per cubic yard to $6.73.

Using the two figures for sand costs as found at Moline, the river sand shows a net saving of $5.26 per cubic yard over the Red Wing bank sand. Thirty cubic yards of sand are needed per filter to make the medium the proper depth, and with the above figures the saving per unit is $158 or $789 for the five 1,000,000 gallon units in the plants.

It has been found that the yearly loss of sand due to various causes is about one cubic yard per filter. With river sand this means an annual loss of $3.65, with bank sand $33.65, or a net saving of $30 per year, using river sand.

Cost records on the cleaning of filters, that is, the removal of the sand and gravel, and the cleaning of the collecting system, show that 120 hours time is necessary for the work, and the expenditure $30. In other words, one unit can be cleaned and the lost sand replaced in the other units for the same amount of money as needed for only replacing the lost bank sand.

It may be said in conclusion that river sand is being used with satisfactory results in a number of filter plants, that the cost is much less than the average bank sand, and that the water works proposing to buy new sand can well afford to investigate the quality and quantity available in their own locality, before purchasing.